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ABSTRACT

This self-paced student training module on types of drawings and views is one of a number of modules developed for Pre-apprenticeship Phase 1 Training. Purpose of the module is to provide students with a working knowledge of orthographic, pictorial, and isometric drawings and types of lines and to teach students to identify them and understand how they are applied in reading blueprints. The module may contain some or all of the following: a cover sheet listing module title, goal, and performance indicator; study guide/checklist with directions for module completion; introduction; information sheets providing information and graphics covering the module topic(s); self-assessment; self-assessment answers; post assessment; and post-assessment answers. (YLB)

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ED217277

INDIVIDUALIZED LEARNING SYSTEMS

# PRE-APPRENTICESHIP PHASE 1 TRAINING

## TYPES OF DRAWINGS AND VIEWS

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## Goal:

Upon completion of this module, the student will have a working knowledge of orthographic, pictorial and isometric drawings and types of lines, and will be able to identify them and understand how they are applied in reading blueprints.

## Performance Indicators:

The student will complete a Self Assessment exam and a Post Assessment exam covering the topics, and will also complete an assignment consisting of six orthographic and isometric drawings.

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# Study Guide

For successful completion of this module, complete the tasks in the order listed below. Check each one off as you complete it.

1. ____ Read the Goal and Performance Indicators on the cover of this module. This will explain what you can be expected to learn from the module and how you will demonstrate it.

2. ____ Read the Introduction section and study the Information section. In these sections you will acquire the knowledge necessary to pass the Self and Post Assessment exams.

3. ____ Complete the required assignments on the Assignment pages. Turn them in to your instructor for review.

4. ____ Complete the Self Assessment exam. This will show how well you can expect to do on the Post Assessment exam. Compare your answers with those on the Self Assessment Answer Sheet found immediately following the exam. If you scored poorly, re-study the Information section or ask your instructor for help.

5. ____ Complete the Post Assessment exam. Turn the answers in to your instructor. It is recommended you score 90% or better before continuing with the next module.

# Introduction

One of the problems in all drawing is how to depict a three-dimensionsal object on a two-dimensional sheet of paper. Any attempt at showing all three dimensions on a single drawing will result in foreshortened lines that will not represent true dimensions of the object. To show an object's true shape, the draftsperson must make two or more related drawings, each of which depicts the object in two of its principal dimensions only--width and depth, width and height, or height and depth. Almost without exception, working drawings are made this way.

Sometimes, however, it is desirable to portray the object more nearly as an observer would normally see it--that is, to show all three principal dimensions at once. Several methods are employed for making drawings of this picture-like type, and all are useful for illustrating the overall shape and general features of technical objects. However, all of these pictorial drawing methods have a common disadvantage that makes them generally unsuitable for the production of working drawings: the true measurements of the object.

# Information

## ORTOHOGRAPHIC PROJECTION

The drawing method almost universally employed in the making of architectural and engineering working drawings is called orthographic projection; the drawings produced in this way are called orthographic or "true" drawings, as opposed to the picture-like drawings made by pictorial drawing methods. Unlike most pictorial drawings, orthographic drawings are drawn to scale, and true measurements can be taken from them.

An orthographic view shows one face or side of an object to the extent that it would be seen by an observer looking squarely at that side or face. No pictorial techniques are employed for an orthographic drawing, the object being shown in its actual form, not is apparent form. This makes it possible for the draftsperson to indicate, in a series of related orthographic views, the true size, shape, and location of every part of the object and to present dimensions in a clear and precise way.

## VISUALIZING THE OBJECT FROM ORTHOGRAPHIC WORKING DRAWINGS

The orthographic-projection drawing method (also called "three-view" or "multiview" drawing) can best be understood from a study of the three most common orthographic views--top, front, and side views--as they are employed in mechanical drawings to represent a simple object, as for example in Fig. F-13.

Each of the three orthographic views in Fig. F-13 reveals the shape of the object as perceived from a particular viewing direction. Collectively, the three views provide a complete illustration of the object. The top view shows it in width and depth. The front view, which is obtained by rotating the object $90^{o}$ on its vertical axis away from the front view, shows it in height and depth. If additional orthographic views are required to complete the description of an object, they will be developed by further $90^{o}$ rotations, and thus will will bear right-angle relationships to the

top, front, and side views. Front, side, and rear views are called elevations. Hidden features are indicated on orthographic drawings by means of dotted lines, as in the front and side views in Fig. F-14.

In an orthographic drawing, only those object lines that are perpendicular to the observer's direction of view--that is, parallel with the picture plane--are shown in their true scale length. The oblique line A-B is drawn in true proportion in the top view in Fig. F-15. In the front view, however, the line A-B is drawn shorter than its true scale length and therefore is not shown in true proportion.

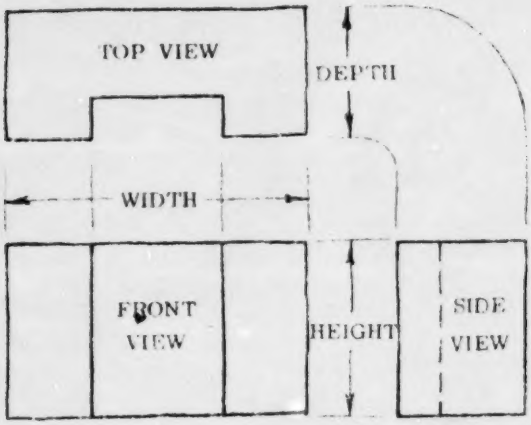



Fig. F 13
Orthographic (multiview) projections

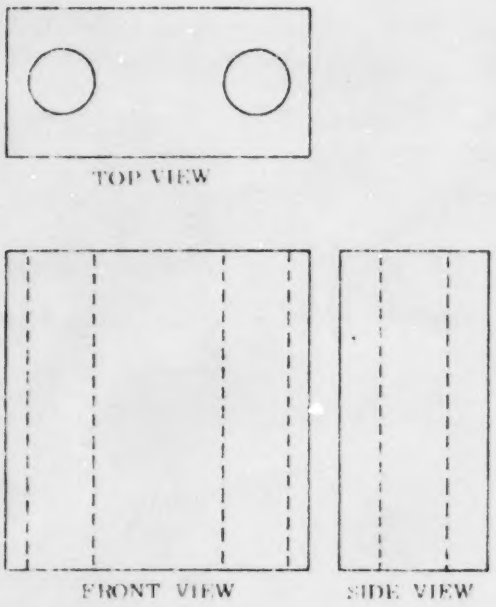



Fig. F-14
Hidden lines in orthographic views

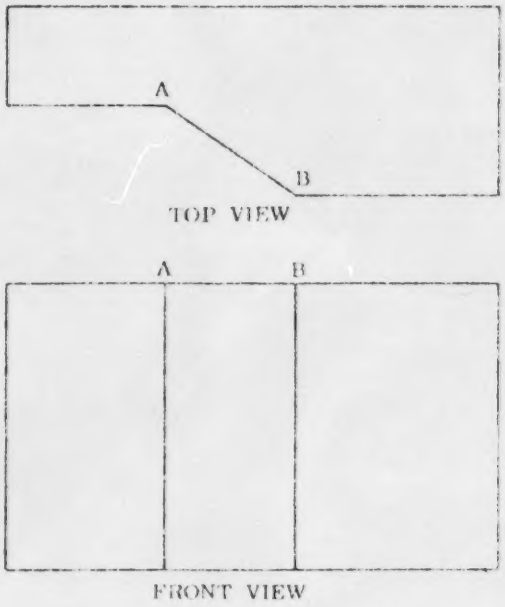



Fig. F-15
Oblique lines in orthographic projection

From this discussion, it will be seen that the shape of an object cannot be visualized from a single orthographic view; all the related views must be studied together. The importance of this rule will become apparent as more complex working drawings are encountered.

TYPES OF LINES IN WORKING DRAWINGS

Several types of lines, each having a specific meaning, are employed in the making of working drawings; some lines are thicker than others, some are solid, and some are broken. Some of the more common types of lines with an example of their application, are shown in Fig. F-16. Such a listing of conventional drafting lines is called an "alphabet of lines."

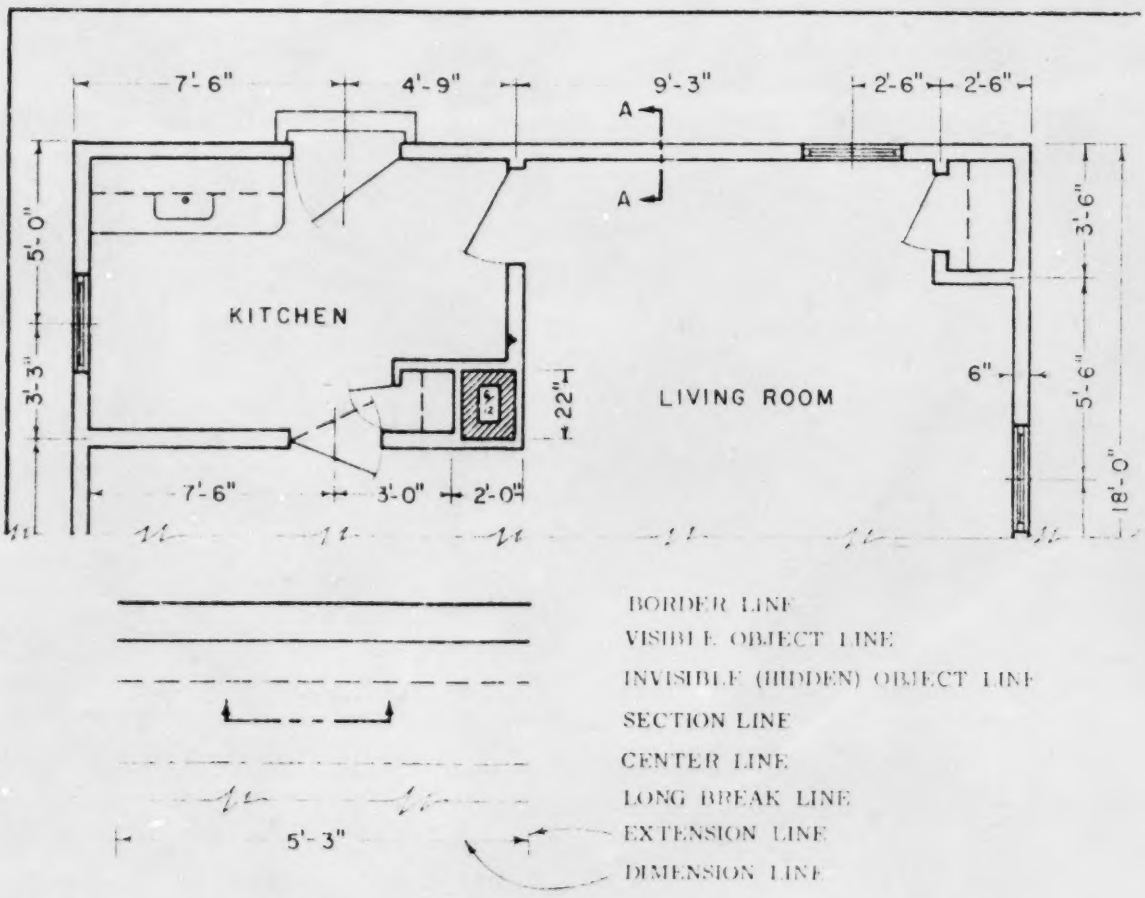



Fig. F-16. Lines used in working drawings.

## PICTORIAL DRAWINGS

Because a pictorial drawing shows more than one face of the object, it can give more information about the shape of the object than would be possible with any single orthographic view. For this reason, persons without technical training find pictorial drawings the easier type to understand. The main disadvantage of pictorial drawings lies in their distortion of true object lines and angles; this makes them unsatisfactory for describing complete and detailed forms. However, they are useful in cases where the measurements of the image need not correspond exactly with those of the actual object. For example, the architect uses a pictorial drawing to show his or her client how the house will look when completed.

The two principal types of pictorial drawings are perspective and axonometric drawings. A third type, the oblique drawing, is partly axonometric and partly orthographic. Because of the distorted appearance of objects drawn by the oblique method, it is not widely used for pictorial representation and will not be discussed further here.

## PERSPECTIVE DRAWINGS

The type of pictorial drawing that represents an object most clearly as it is seen by the human eye is the perspective drawing. The optical line relationships in a perspective drawing are like those in a photograph; that is, all lines that are parallel on the actual object tend to converge at some distant point on the drawing.

Perspective drawings are seldom used as working drawings; they are used mainly in sales and promotion work and as architectural "presentation" drawings.

## AXONOMETRIC DRAWINGS

The term "axonometric" refers to the class of pictorial drawings in which all the measurements necessary for making the drawing are made on the three principal axes of the object or on lines parallel with those axes. A rectangular solid drawing in this way consists of three sets of lines, each set being parallel to one of the principal axes, and reveals three of its faces. An infinite number of axonometric positions is possible, the choice of position depending upon how the object is to be viewed. (See Fig. F-17.) The isometric position, second from the right in the illustration, is the one most often employed. An axonometric drawing in the isometric position is called an isometric drawing.

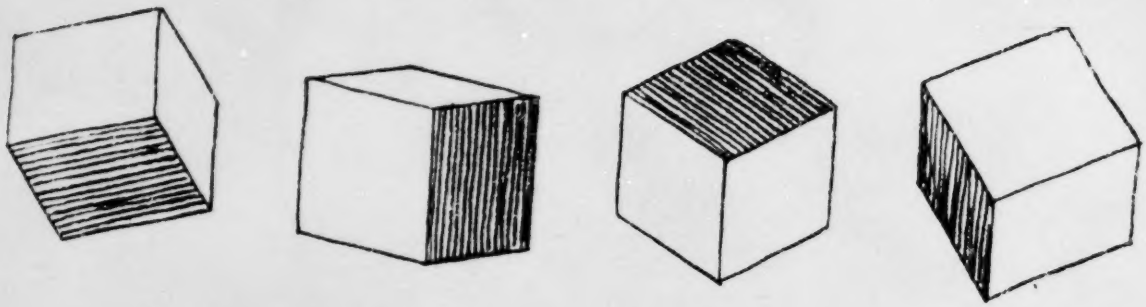


Fig. F-17. Axonometric drawings in several positions

THE THEORY OF ISOMETRIC DRAWING

The Theory of isometric drawing is that the object is viewed from the exact position in which three of its sides are seen equally foreshortened. In making an isometric drawing, the draftsperson first lays out the three isometric axes--one vertical and other two tipped up $30^{o}$ from a horizontal base line, as shown in Fig. F-18. The height, width, and depth of the object are measured off on these axis lines. Since all lines on or parallel with the isometric axes are foreshortended equally, they will be in true proportion; however, they will never appear as true scale lengths, as do the lines in orthographic drawings. The relationship of an isometric view and three orthographic views of an object is shown in Fig. F-19.

ANGLES IN ISOMETRIC DRAWINGS

Angles cannot be directly transferred from orthographic drawings to isometric drawings; this is so because angles do not appear in their true shape in isometric drawings. To transfer angles in making an isometric drawing from orthographic views, the draftsperson first transfers the intersection points of the lines that form the angles, then draws the angles from the transferred points. (See Fig. F-20.)

CURVES IN ISOMETRIC DRAWINGS

Like angles, curves suffer distortion in being transferred from orthographic drawings to isometric drawings. To transfer a curve, the draftsperson first plots points on the isometric drawing from similar locations along the curve on the orthographic drawing, then connects the points with a curved line. (See Figs. F-21 and F-22.) To simplify transferring the points, he or she may lay out a grid of rectangular coordinates on the multiview drawing and a corresponding isometric grid on the sheet for the isometric drawing.

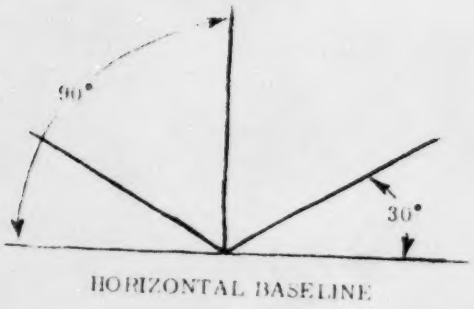



Fig. F-18. Layout of isometric axes

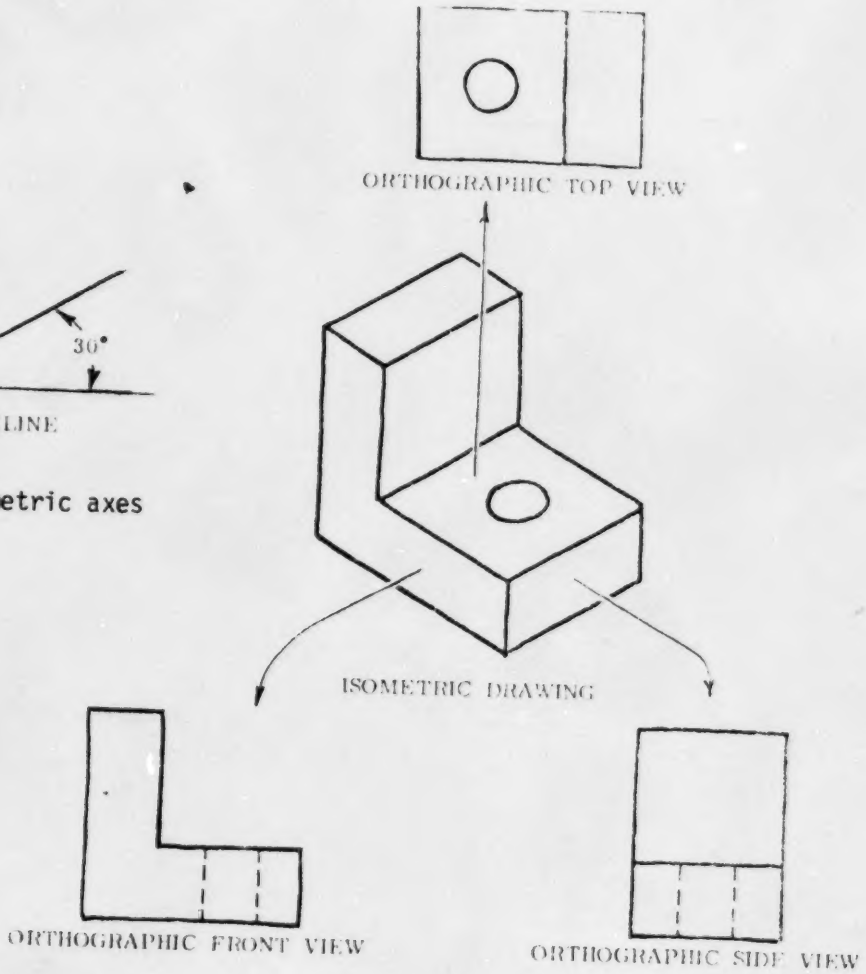



Fig. F-19
Isometric drawing and orthographic views of an object

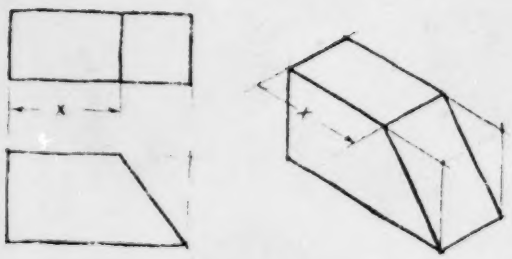



Fig. F-20
Orthographic projection and isometric drawing of an object with an angled surface

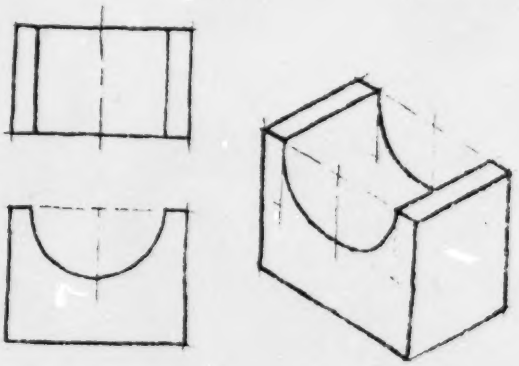


Fig. F-21
Orthographic projection and isometric drawing of an object with a curved surface

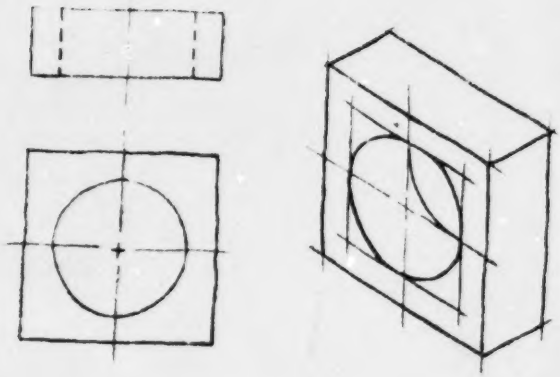
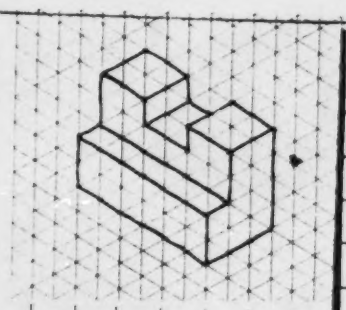


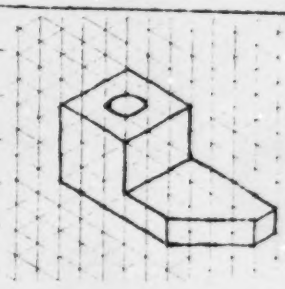
Fig. F-22

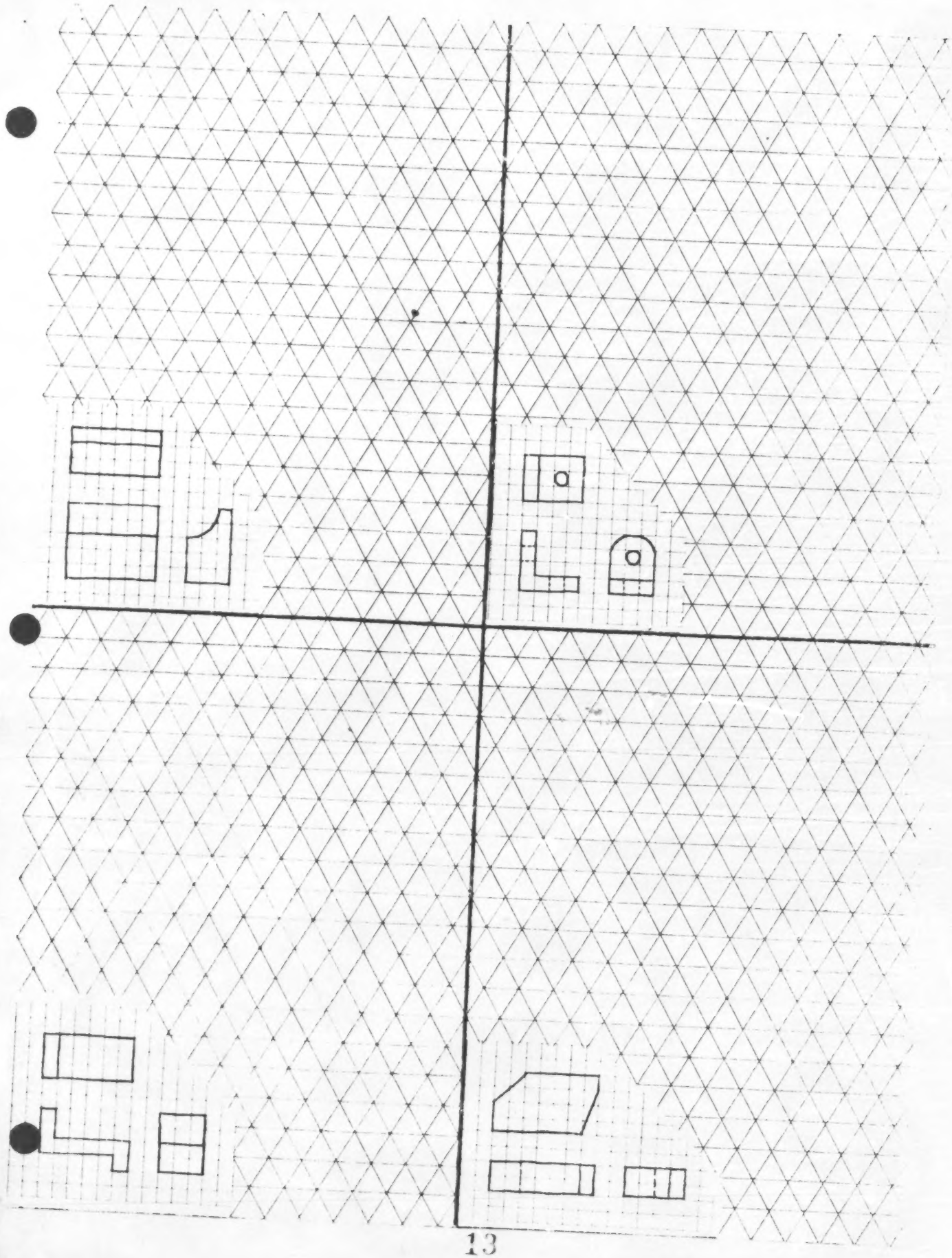
Orthographic projection and isometric drawing of an object with a center hole

# Assignment

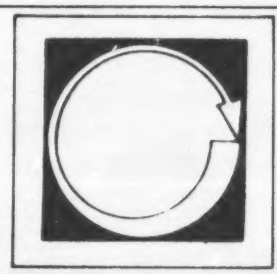
In each of the two rectangular grids on this page, sketch the top, front, and right side views of the object shown in the small isometric drawing. In each of the four isometric grids on the following page, make isometric sketches of the object shown in the small multiview drawing.







# Self Assessment



After you have studied the material in the module, complete the exercises by writing in the word that belongs in each space.

1. The drawing method used for making most working drawings is called _____.

2. Orthographic drawings are drawn to _____ and _____ measurements can be taken from them.

3. An orthographic view shows only one _____ or _____ of an object.

4. In architectural drawings, a view from above is called a(n) _____ view.

5. A listing of conventional drafting lines used in the making of a working drawing is called a(n) _____ of _____.

6. The type of drawing that represents an object most nearly as it would be seen in a photograph is a(n) _____ drawing.

7. A pictorial drawing shows more than one _____ of an object.

8. The type of pictorial drawing in which all of the principal axes are equally foreshortended is the axonometric drawing.

9. In an isometric drawing, two of the three principal axes are tipped up _____ degrees from the horizontal; the third axis is _____.

SELF ASSESSMENT ANSWER SHEET

1. orthographic projection
2. scale, true
3. face, side
4. top
5. alphabet, lines
6. pictorial
7. view
8. axonometric
9. $30^{o}$, $90^{o}$

# Post Assessment

Listed below each numbered item are four possible answers or completing phrases. Decide which of the four is correct, or most nearly correct; then write the corresponding letter in the blank space to the left of that item.

1. ____ The drawing method almost universally employed for making working drawings is called:

   a. orthographic projection
   b. isometric projection
   c. perspective drawing
   d. scaling

2. ____ One disadvantage of pictorial drawings is that in general they:

   a. are too large for use on the job
   b. are suitable only for exterior views
   c. do not accurately represent object lines and angles
   d. give a poor overall view of an object

3. ____ An isometric drawing is one kind of:

   a. orthographic drawing
   b. perspective drawing
   c. axonometric drawing
   d. multiview drawing

4. ____ An orthographic view shows how many sides or faces of an object?

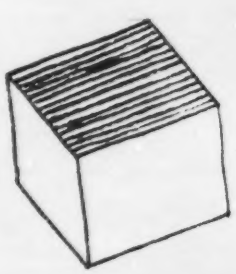
   a. one
   b. two
   c. three
   d. four

5. ____ The true shape of an object cannot be visualized from a single:

   a. orthographic view
   b. perspective view
   c. pictorial view
   d. axonometric view

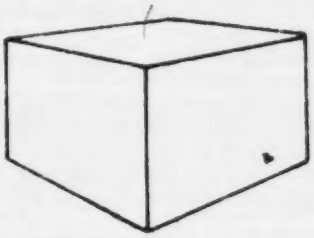
6. ____ The drawing shown below is properly called:

   a. pictorial
   b. orthographic
   c. multiview
   d. isometric



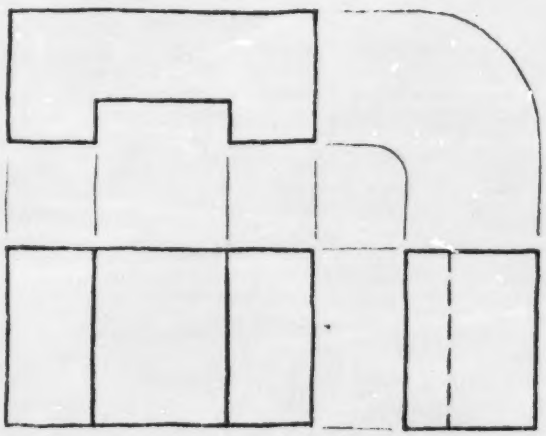
7. ____ The drawing shown below is properly called:

a. perspective
b. isometric
c. axonometric
d. orthographic



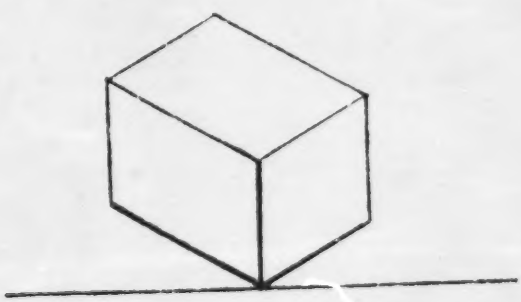
8. ____ The drawing shown below is properly called:

a. pictorial
b. perspective
c. axonometric
d. orthographic



9. ____ The drawing shown below is properly called:

a. multiview
b. orthographic
c. oblique
d. isometric



10. ____ The drawing shown below is properly called:

a. pictorial
b. multiview
c. isometric
d. orthographic